Tuning Nanoscale Organic Materials for Optimal Photovoltaic Functions

Organic photovoltaic materials (OPM) are promising due to their high processability, flexibility, and cost effectiveness, however, the main drawback is their low light conversion efficiencies. In order to improve the efficiency, rapid charge separation upon irradiation, slow charge recombination, and efficient charge transfer must be accomplished. In this poster, we present newly designed donor-acceptor molecules with built-in covalent linkages that facilitate the charge separation and allow efficient molecular packing to improve the overall photo-efficiency. Transient absorption decay measurements using oligo(thiophene) covalently linked with two perylenediimide segments indicated that the charge separation between the donor and acceptor segments is at least one order of magnitude faster than that of the charge recombination. This is a very promising step toward highly efficient OPM.

Significance

"Donor and acceptor segments with built-in covalent linkages" is a new concept for organic photovoltaic materials. Preliminary result of ultra-fast charge separation from solution phase study indicated this is a good first step toward high efficiency. We have utilized small angle neutron and x-ray scattering techniques to characterize the self assembly behavior of diblock copolymers in the past. It is anticipated that these newly designed block copolymers will undergo self alignment with segments of similar chemical nature grouped together. This self assembly process is expected to improve the charge transfer and further enhance the photovoltaic property. The self assembly study of similar block copolymers has been published in *Chem. Eur. J. 10,* 986 **2004**. This is a collaborative effort between University of Chicago, CHM and MSD for the solar energy initiative.

Performers

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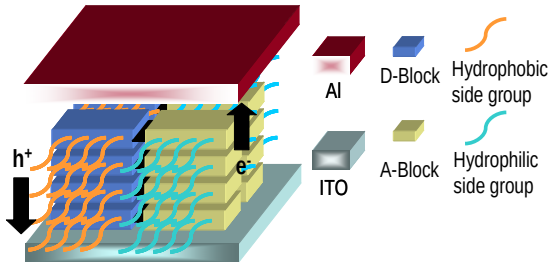
Optimizing Hierarchic Assembly of OPMs

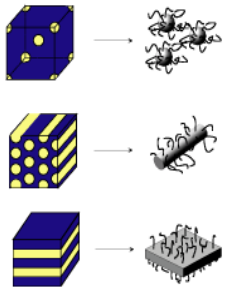
Plan:

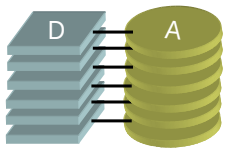
3. Prototype OPM cells

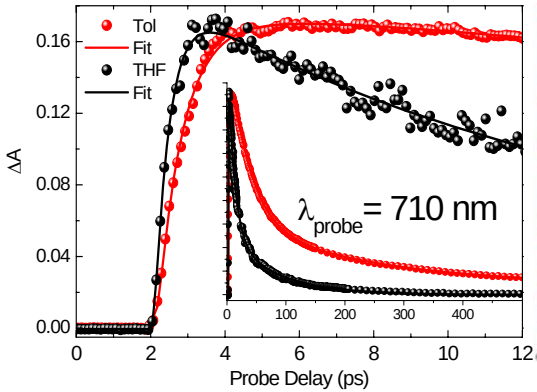
2. Self-assembled thin films with nanostructures

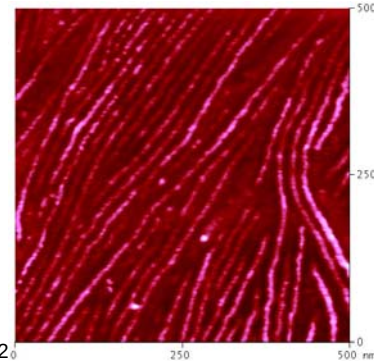
1. Molecular donor/acceptor building blocks









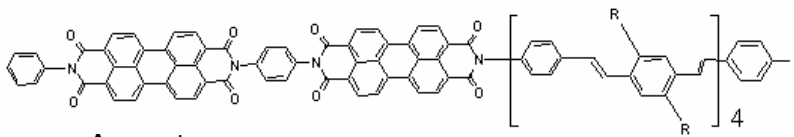


Fast charge separation has been observed in D-A (thiophene-perylenediimide) pairs

Block copolymers are well known to undergo micro-phase separation

Remove the bottleneck for exciton diffusion through D or A domains — intra-molecular charge transfer.

It is envisioned that the Donor-Acceptor diblock copolymers will undergo phase separation to facilitate charge transport and achieve overall high solar power conversion.



Acceptor Donor

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